

# BOPYRID ISOPODS PARASITIZING HERMIT CRABS IN THE NORTHWESTERN ATLANTIC OCEAN

John C. Markham

## ABSTRACT

Recent extensive sampling of hermit crabs along the northwestern Atlantic coast from Canada to Brazil has produced 19 species infested by 11 different species of bopyrid isopods belonging to two subfamilies plus two specimens which may represent undescribed species. Of the 11 species, two are described as new, eight are recorded from new localities and/or new hosts, and one, a new species being described elsewhere, is mentioned. A key to the species considered is provided, complete synonymies for all species are presented or cited, and previously published accounts of their occurrence are summarized. Additional descriptive notes, where appropriate, are presented for the species already described. A brief discussion of the distribution of those bopyrids infesting hermit crabs in the region is included.

Material representing two new species of bopyrid isopods infesting hermit crabs in the northwestern Atlantic has recently become available. In addition, previously unreported material of eight other species of such parasites has been found. Thus it seemed timely to summarize all of the data known for bopyrids infesting hermit crabs in this region. Distribution of material is as follows: Bermuda Biological Station for Research, reference collection (designated BBS); Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands (RMNHL); Invertebrate Museum, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida (UMML); Smithsonian Institution, National Museum of Natural History (USNM); and Universitetets Zoologiske Museum, Copenhagen (ZMK).

### KEY TO SUBFAMILIES, GENERA AND SPECIES CONSIDERED, BASED ON MATURE FEMALES

(Applicable only to those bopyrids infesting hermit crabs in Northwestern Atlantic Ocean)

- 1a. Occurring within branchial chamber of host; brood pouch more or less enclosed by 5 pairs of loosely overlapping oostegites ..... Subfamily Pseudioninae 2
- 1b. Clinging to dorsal surface of host's abdomen; brood pouch as large flaccid sac completely enclosed by fused oostegites ..... Subfamily Athelginae 6

- 2a. Pereopodal propodi produced into large flat sections with depression receiving sharply pointed dactyli ..... *Asymmetrione* 3
- 2b. Pereopodal propodi not so produced ..... 4
- 3a. Body moderately distorted with left side longer (sinistral) ..... *A. desultor*
- 3b. Body greatly distorted with right side longer (dextral) ..... *A. clibanarii*
- 4a. Body axis nearly straight; head extending beyond margin of pereon; pleopods completely covering pleon ventrally ..... *Parapagurion imbricata*
- 4b. Body axis distorted at least 30°; head not exceeding margin of pereon; pleopods only slightly covering pleon ventrally ..... 5
- 5a. Pleon of 6 pleomeres; uropods biramous, endopodites extending prominently posteriorly ..... Undescribed genus and species
- 5b. Pleon of 5 pleomeres; uropods uniramous, not visible in dorsal view ..... *Bopyrissa wolffi*
- 6a. Lateral plates on all or most pleomeres ..... 7
- 6b. Lateral plates absent from all pleomeres ..... *Parathelges* 8
- 7a. Brood pouch produced into posterior sac on right side only ..... *Stegophryxus hyptius*
- 7b. Brood pouch nearly symmetrical ..... *Stegias clibanarii*
- 8a. Basal segments of pereopods 5-7 with large posterior knobs ..... *P. tumidipes*
- 8b. Basal segments of pereopods without posterior knobs ..... 9
- 9a. Pleomeres completely fused or only indistinctly separated ..... *P. piriformis*
- 9b. Pleomeres distinctly separated ..... 10
- 10a. Peduncles of pleopodal exopodites at least half as long as total appendage length ..... *P. foliatus*
- 10b. Peduncles of pleopodal exopodites less than half as long as total appendage length ..... *P. occidentalis*

Subfamily PSEUDIONINAE R.  
Codreanu, 1967

*Asymmetrione* Codreanu, Codreanu  
and Pike, 1965

Type-species, by original designation,  
*Pseudione asymmetrica* Shiino, 1933. Total  
number of species described, seven.

*Asymmetrione desultor* Markham, 1975

*Asymmetrione desultor* Markham, 1975c: 255–  
260, figs. 1–4 (Type-locality, Miami, Florida).

**Material examined.**—Infesting *Pagurus provenzanoi* Forest and de Saint Laurent, J. C. Markham, coll., P. A. McLaughlin, det. of hosts. Sta. JCM:D-131, Westpuntbaai, Curaçao, 12°21.3'N, 63°09.3'W, 8 m, on coral reef, 8 Apr. 1974: 1 ♀, 1 ♂, UMML 32.5318. Sta. JCM:D-144, Portomaribaai, Curaçao, 12°13.0'N, 69°05.4'W, 15 m, among corals on reef, 13 Apr. 1974: 1 ♀ (immature), 1 ♂, UMML 32.5317. Sta. JCM:D-136, southern end Bonaire, 12°05.0'N, 68°17.5'W, 16 m, on coral reef, 10 Apr. 1974: 1 ♀, 1 ♂, in collection of P. A. McLaughlin.

**Previous records.**—Holotype and allotype infesting *Pagurus bonairensis* Schmitt, Miami, Florida. Paratypes infesting *P. longicarpus* Say, Morehead Channel, North Carolina; infesting *P. provenzanoi* Forest and de Saint Laurent, off Antigua; infesting *Pylopagurus* sp., off Key Largo, Florida, and Cay Sal Bank.

**Discussion.**—The new material does not differ appreciably from the original description, which was based on a fairly large series. The geographic range is extended somewhat south and west from Antigua, but this host record is not new.

*Asymmetrione clibanarii* Markham, 1975

*Asymmetrione clibanarii* Markham, 1975c: 260–  
263, figs. 5, 6 (Type-locality, Miami, Florida).

**Material examined.**—Infesting *Clibanarius* sp. (possibly n. sp., near *C. tricolor* (Gibbes)). Sta. RBM:Asc-11, intertidal pools and subtidal rocky shore, rocky point at north edge English Bay, Ascension Island, ca. 07°55'S, 14°20'W, R. B. Manning, coll. and det. of host: 1 ♀, 1 ♂, in collection of R. B. Manning.

**Previous records.**—Type specimens infesting *Clibanarius tricolor* (Gibbes) in southern Florida and Berry Islands, Bahamas.

**Discussion.**—This is the first record of *A. clibanarii* infesting a host species other than *Clibanarius tricolor*, although Raymond Manning (personal communication) informs me that there remains some doubt whether the host is really distinct from *C. tricolor*. The extension of range, to Ascension Island off the coast of Africa, the first record of a bopyrid from that island, is highly noteworthy. This is the only hermit-crab infesting bopyrid so far recorded from both the northern and southern Atlantic. The new material does not differ from the description of this species already published.

*Bopyrissa* Nierstrasz and Brender  
à Brandis, 1931

Type-species, by monotypy, *Bopyrissa magellanica* Nierstrasz and Brender à Brandis, 1931. Total number of species described, five.

**Remarks.**—R. Bourdon (personal communication) has pointed out that *Urocryptella* Codreanu and Codreanu (1963) is a junior synonym of the previously monotypic genus *Bopyrissa*. He plans to publish a report on this shortly. This combination of genera, with which I fully agree, and the description of the new species below bring the number of species of *Bopyrissa* to five.

*Bopyrissa wolffi* new species  
Figures 1–5

*Stegias clibanarii*, Pearse, 1932: 4–5, figs. 22–26 [in part].—Schultz, 1969: 323, fig. 514. [Not *Stegias clibanarii* Richardson, 1904.]

*Pseudione* sp., Menzies and Glynn, 1968: 17–18, fig. 2A–B.—Markham, 1972: 64; 1975b: 228. —McDermott, 1974: 2.

**Material examined.**—Infesting *Clibanarius tricolor* (Gibbes), all hosts coll. and det. by J. C. Markham, except where otherwise noted. In shallow tide pool on rocky ledge near Saucos Hill, south shore Bermuda, 15 Sept. 1974: 1 ♀ (immature), BBS. In vicinity of Miami, Florida, Mar. 1968, R. W. Heard, coll. and det. of host: 1 ♀, 1 ♂, UMML. Under loose cobbles at water's edge, south jetty, Key Colony Beach, Monroe County, Florida, 2 June 1970: 2 ♀, 2 ♂, ZMK. Same locality, 13 Sept. 1970: 1 ♀ (holotype), USNM 154608, 1 ♂ (allotype), USNM 154608, 11 other ♀, 10 other ♂, USNM 154609. Beneath coral

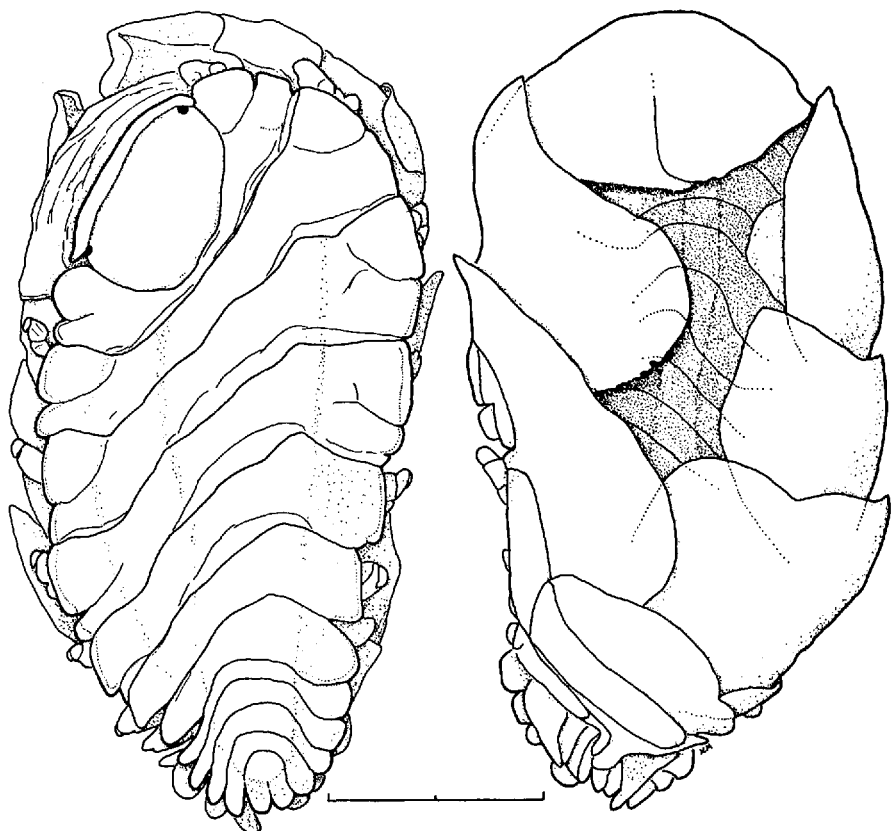


Figure 1. *Bopyrissa wolffi*, n. sp., holotype female, dorsal and ventral. Scale: 1.0 mm.

rubble, east side Garden Key, Dry Tortugas, Florida, 4 May 1971: 1 ♀, USNM 154612. Dry Tortugas, Florida, 15 July 1931, A. S. Pearse, coll. and det. of host: 1 ♀, 1 ♂, USNM. Beneath cobbles in shallow water, west side Anderson Cay, Berry Islands, Bahamas, 3 July 1971: 3 ♀, 3 ♂, USNM 154613.

Infesting *Clibanarius vittatus* (Bosc). Bogue Sound near Morehead City, North Carolina, 2.5 m, on sand and shells, 10 May 1972, T. Wolff, coll. and det. of host: 1 ♀, 1 ♂, ZMK. San Luis Pass, Galveston, Texas, 10 Aug. 1975, N. Fotheringham, coll. and det. of hosts: 3 ♀, 1 ♂, USNM 154610.

**Previous records.**—Reported by Menzies and Glynn (1968) infesting *Clibanarius tricolor* in Puerto Rico and by McDermott (1974) from the same host species in Bermuda. The specimens previously mentioned by Markham (1972, 1975b) and some of those misidentified as *Stegias clibanarii* by

Pearse (1932) are among the material listed above.

**Description of holotype female** (Figs. 1, 2).—**Dimensions.** Length 3.6 mm, width 1.8 mm, head length 0.6 mm, pleon length 1.0 mm. Distortion of head-pereon axis  $54^\circ$ , pereon-pleon axis slightly recurved.

Body evenly curved, all body regions and segments distinctly separated (Fig. 1).

Head oval,  $\frac{2}{3}$  as long as wide, small frontal lamina extending along whole anterior margin but not along sides. Antennae markedly reduced. Eyes small but distinct, immediately behind frontal lamina. Posteroventral border of head (Fig. 2A) with single pointed lateral projection on

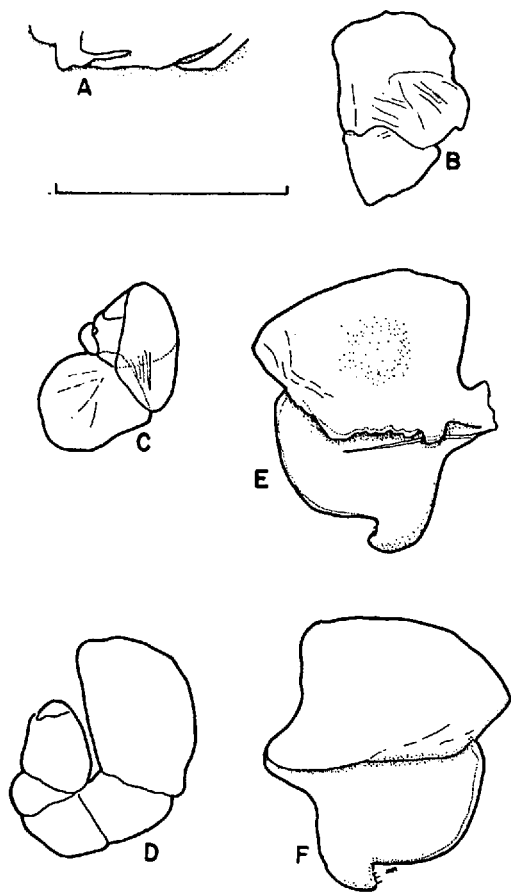


Figure 2. *Bopyrissa wolffi*, n. sp., holotype female. A, Posteroventral border of head; B, Right maxilliped; C, Right pereopod 1. D, Right pereopod 7; E, Right oostegite 1, internal; F, Same, external. Scale: 1.0 mm for A, B, E, F; 0.4 mm for C, D.

each side, central margin entire. Maxilliped (Fig. 2B) with irregular lateral margin, lacking palp.

Pereon broadest across pereomere 3. Slightly raised broad middorsal ridge continuing along whole pereon and onto pleon. Coxal plates distinct on both sides of pereomeres 1–4. Pereopods (Fig. 2C, D) quite small relative to body size, somewhat increasing in size posteriorly; dactyli all reduced and blunt. Oostegites extending beyond body sides, incompletely enclosing brood pouch; oostegite 1 (Fig. 2E, F)

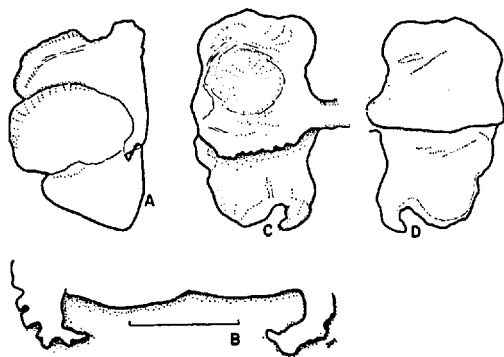


Figure 3. *Bopyrissa wolffi*, n. sp., paratype female. A, Right maxilliped; B, Posteroventral border of head; C, Right oostegite 1, internal; D, Same, external. Scale: 0.65 mm for A; 0.50 mm for B; 1.00 mm for C, D.

rounded anteriorly, with sparse blunt teeth on internal ridge, blunt posterolateral point curved laterally and bearing some setae subterminally.

Pleon of five pleomeres, all produced into rounded lateral plates, those on convex side broader and slightly overlapping. Four pairs of biramous irregularly shaped pleopods with exopodites much larger than endopodites; pleopod 1 largest, others much reduced. Uropods uniramous, similar to pleopodal rami.

*Color when fresh* (as recorded by Torben Wolff).—Head pale yellow at center. Red to tan anterior region of digestive tract visible near posterior margin of head. Pereomeres with narrow transverse lines, middle ones yellow, anterolateral ones white. Gonad showing red and faint blue through some pereomeres. Pleomeres brown medially, each with light stripe along posterior margin extending laterally.

*Variations*.—Of the 24 other females examined, all correspond with the holotype in most details. Their lengths range from 1.6 to 6.0 mm and widths from 0.9 to 4.3 mm; the ratio of length to width varies from 1.40 to 2.20. The angle of head-pereon distortion is variable, from 22° to 54°, and the pereon-pleon reverse distortion varies as

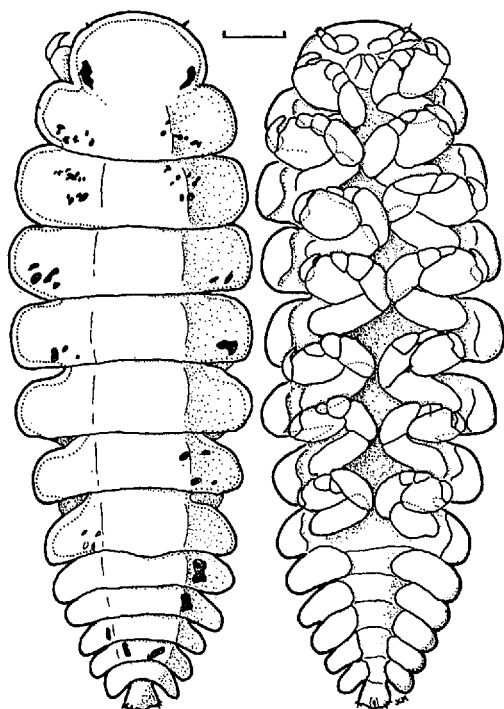


Figure 4. *Bopyrissa wolffi*, n. sp., allotype male, dorsal and ventral. Scale: 1.0 mm.

well. In one female, most of the pleomeres are partly fused; in another the pleon is rather extended. The largest female (Fig. 3), a parasite of *Clibanarius vittatus*, has a more distinctly segmented maxilliped (Fig. 3A), crenulate projections on the postero-ventral border of the head (Fig. 3B) and a recurved point on the first oostegite (Fig. 3C, D).

*Description of allotype male* (Figs. 4, 5).—Dimensions. Length 1.10 mm, maximal width 0.38 mm, head length 0.16 mm, pleon length 0.24 mm.

Sides of body subparallel, not abruptly narrowing at any point. Head fused with pereomere 1, body segments otherwise separated. Irregular scattered pigment spots on lateral regions of nearly all pereomeres and pleomeres (Fig. 4).

Head oval, much wider than long. Eyes, as elongate streaks, near posterolateral mar-

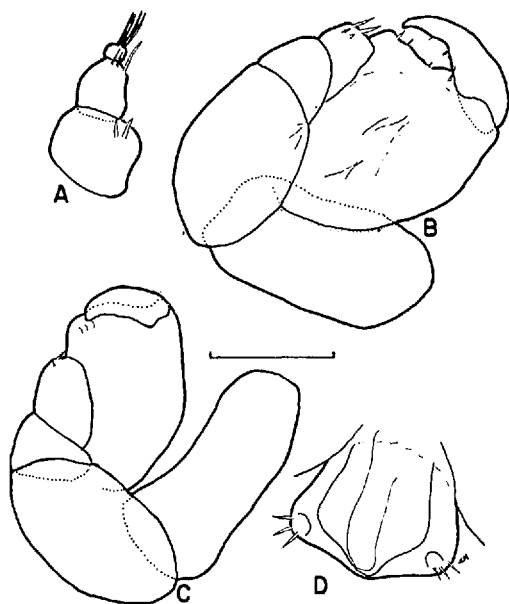


Figure 5. *Bopyrissa wolffi*, n. sp., allotype male. A, Right antenna 1; B, Left pereopod 1; C, Left pereopod 7; D, Terminal pleomere, ventral. Scale: 0.05 mm for A-C; 0.04 mm for D.

gins. Antenna 1 (Fig. 5A) of three segments, progressively smaller distally, each bearing small tuft of setae on distal margin. Antenna 2 obscurely segmented (maybe of four segments), only distal segment bearing one or two setae.

Pereon broadest across pereomeres 3 and 4; slight middorsal ridge along pereon and most of pleon; edges of all pereomeres nearly square; no midventral tubercles. Pereopods (Fig. 5B, C) progressively somewhat smaller posteriorly, dactyli progressively less pointed and proportionately smaller posteriorly.

Pleon of six pleomeres, all of nearly same length (about half of length of pereomeres), tapering smoothly posteriorly. Prominent sessile pleopods on pleomeres 1-5, covering about  $\frac{2}{3}$  of total width of ventral surface. Terminal pleomere (Fig. 5D) triangular and broadest at posterior border, produced into small anal cone,

lacking uropods but with corners bearing tufts of setae.

**Variations.**—Among the other 17 males examined, there is little significant variation. They range in length from 0.6 to 1.9 mm, in width from 0.3 to 0.8 mm; the ratios of lengths to widths vary from 1.76 to 3.25. In several males, the head and pereon are distinctly separated. One male has only five pleomeres, but this may be due to damage; in another, pleomere 6 is rather deeply embedded in pleomere 5.

**Etymology.**—The specific name *wolffi* has been selected to acknowledge the contribution made by Torben Wolff in providing color notes and graciously placing his material at my disposal for description.

**Discussion.**—*Bopyrissa wolffi* exemplifies well all of the characters of its genus. The females are doubly distorted into an approximate S-shape; their frontal laminae are present but reduced; only five pleomeres are present; there are four pairs of biramous pleopods and a pair of uniramous uropods. The males have six-segmented pleons and bear five pairs of broad flat sessile pleopods. Of the four species of *Bopyrissa* previously described (including three originally assigned to *Urocryptella*), *B. dawydoffi* (Codreanu and Codreanu, 1963) is distinguishable from all of the other species by the structure of its female's lateral plates, which extend considerably beyond the sides of the pereon. *B. wolffi* is most similar to *B. magellanica* Nierstrasz and Brender à Brandis (1931), especially among immature females of the former. Females of *B. wolffi* differ from those of *B. magellanica* in being broader relative to their widths and in having less well developed pleopods; males of *B. wolffi* have slightly less extended heads and more square-cornered pereomeres than those of *B. magellanica*.

Most of the species of *Bopyrissa* occur in only dextral or sinistral forms but not both. Thus *B. dawydoffi* is known only from the

left branchial chambers of its hosts (sinistral form), and *B. fraissei* (Carayon, 1943) is exclusively dextral. All 25 females of the type series of *B. wolffi* and the eight specimens of the type series of *B. magellanica*, which I have examined, are dextral. Only *B. diogeni* (Popov) is known in both forms, though dextral ones predominate overwhelmingly (Bourdon, 1968).

With the incorporation of *Urocryptella* into *Bopyrissa* and the description of this new species, the genus *Bopyrissa* is now known to be completely pantropical in distribution. All of the species infest diogenid hermit crabs of the genera *Clibanarius* and *Diogenes*. Only two species are recorded from more than a single species of host. The record of *Bopyrissa wolffi* infesting *Clibanarius vittatus* in Texas is evidently the first report of any bopyrid parasitizing a hermit crab in the Gulf of Mexico.

#### *Parapagurion* Shiino, 1933

Type-species, by monotypy, *Parapagurion calcinicola* Shiino, 1933. Total number of species described, two.

#### *Parapagurion imbricata* new species

Figures 6–9

**Material examined.**—Infesting *Parapagurus* sp. (probably new), P. A. McLaughlin, det. of host. PILLSBURY Sta. P-770, off Península de la Guajira, Colombia, 13°00'N, 71°44'W, 1225–1420 m, 28 July 1968: 1 ♀ (holotype), 1 cryptoniscan larva, USNM 150715.

Infesting *Paguristes tortugae* Schmitt, W. L. Schmitt, coll. and det. of hosts. Varadero, south shore of Península de Hicacos, Bahía de Cárdenas, Cuba, 2 m, 27 Jan. 1957: 1 ♀, 1 ♂ (damaged), USNM 102015. Xanadu, Península de Hicacos, Cuba, dredged from unrecorded depth, 27 Jan. 1957: 1 ♀, 1 ♂ (allotype), USNM 102021.

**Description of holotype female** (Figs. 6, 7).—Dimensions. Length, 4.8 mm; maximal width, 2.9 mm; head length, 1.1 mm; pleon length, 1.2 mm. Distortion, 16°.

Body evenly tapered, subovate in outline except for truncate posterior border. All body regions and segments distinct (Fig. 6).

Head nearly square, deeply set into pereomere 1. Antennae (Fig. 7A) prominent, of three and six segments, respectively, situ-

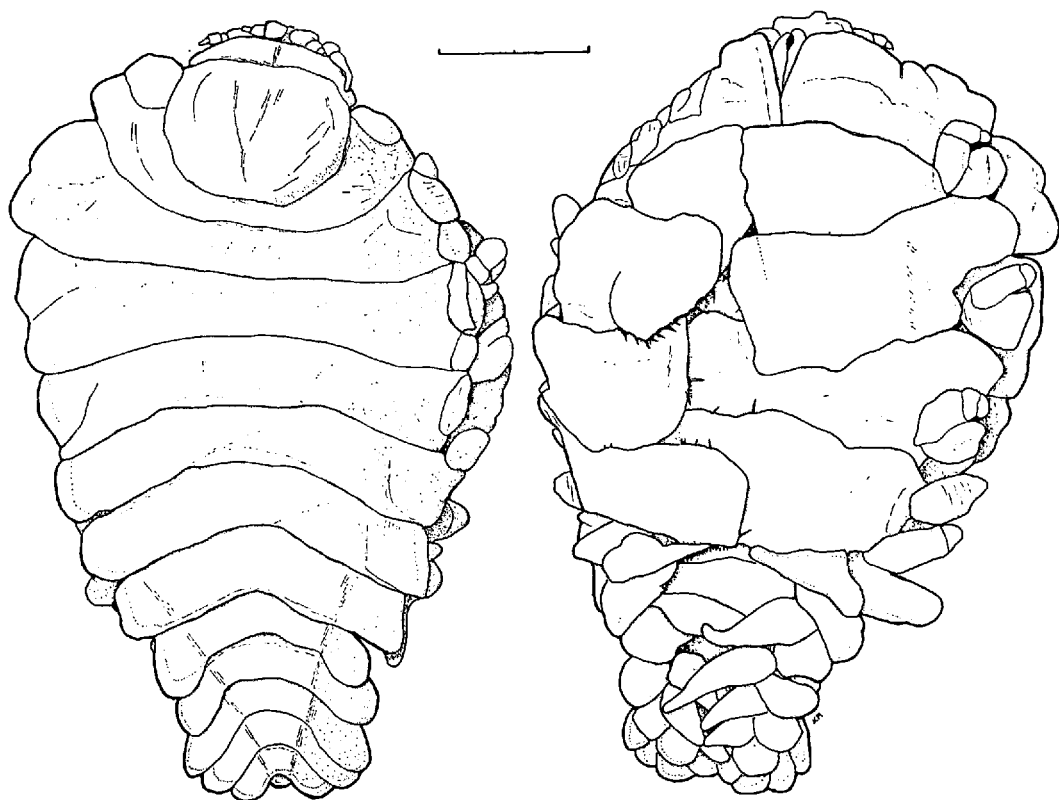


Figure 6. *Parapagurion imbricata*, n. sp., holotype female, dorsal and ventral. Scale: 1.0 mm.

ated far anteriorly, each tipped with some setae. Posteroventral border of head (Fig. 7B) with blunt central point and greatly reduced single lateral projection on each side. Maxilliped (Fig. 7C) with prominent non-articulated palp bearing several long setae on distomedial margin; adjacent anteromedial margin of maxilliped bearing similar setae.

Pereon broadest across pereomere 3. Pereomeres 1–4 with coxal plates on concave side of body. Oostegites almost completely enclosing brood pouch, several with sparse setae on medial and anterior margins; oostegite 1 (Fig. 7D, E) slightly rounded anteriorly, with unornamented internal ridge, straight and rather sharp posterolateral point. Pereopods (Fig. 7F, G) slightly larger posteriorly, otherwise essentially alike.

Pleon of six pleomeres, first four of nearly equal width, fifth abruptly narrower, sixth greatly reduced and deeply embedded in fifth, making pleon truncate posteriorly; sides of pleomeres not produced into lateral plates. Pleopods of all five pairs (Fig. 7H) biramous, progressively smaller posteriorly; endopodites lanceolate, elongate, extending medially, almost completely covering ventral surface of pleon in imbricate pattern; exopodites ovate, extending laterally, not exceeding margins of pleon. Terminal pleomere bearing pair of ovate uniramous uropods very similar to pleopodal exopodites.

*Variations.*—Both of the paratype females differ from the holotype (whose dimensions are nearly twice as great) in some characters. Their heads do not exceed the edges

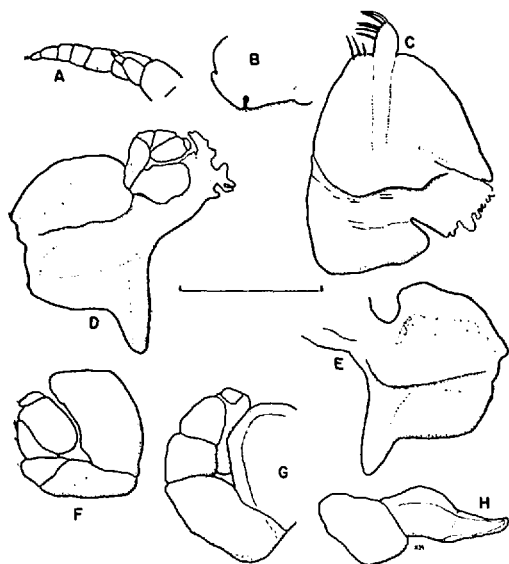


Figure 7. *Parapagurion imbricata*, n. sp., holotype female. A, Left antennae; B, Right postero-ventral border of head; C, Left maxilliped; D, Left oostegite 1, external; E, Same, internal; F, Left pereopod 1; G, Left pereopod 6; H, Right pleopod 1; Scale: 0.5 mm for A, C, F, G; 1.0 mm for B, D, E, H.

of the first pereomeres; the posteroventral borders of their heads bear single curved projections on each side; and their first oostegites bear a few blunt teeth on their internal ridges.

*Description of allotype male* (Figs. 8, 9).—Dimensions. Length, 1.2 mm; maximal width, 0.5 mm.

Head only obscurely separated from pereomere 1, all other body regions and segments distinct. Body not abruptly narrowing anywhere (Fig. 8).

Head sharply reflexed ventrally. Eyes conspicuous, rather large, irregularly shaped, extending into pereomere 1. Antennae (Fig. 9A) both evidently of three indistinctly separated segments, bearing tufts of setae terminally and sparse setae on middle segments.

Pereon slightly broadest across pereomere 4, tapering gradually posteriorly from

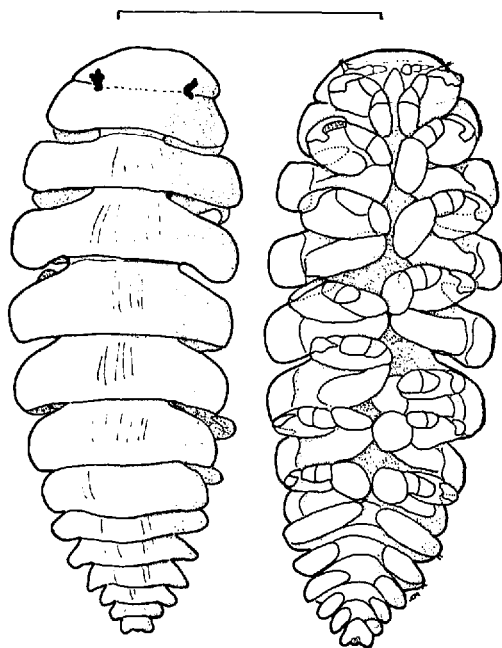


Figure 8. *Parapagurion imbricata*, n. sp., allotype male, dorsal and ventral. Scale: 0.5 mm.

there. Pereomeres 3–6 all of nearly same length, others slightly shorter; all with lateral parts separated by gaps. No midventral tubercles. All pereopods (Fig. 9B, C) equally well developed, pereopods 2–4 slightly larger than others; dactyli of pereopods 5–7 proportionately smaller than others; setae on margins of propodi.

Pleon of six well-defined pleomeres, all of nearly same length but progressively much smaller posteriorly, all with more or less pointed sides. Flat oval sessile pleopods on pleomeres 1–5, each covering approximately 0.33 of ventral side of its pleomere, progressively smaller posteriorly. Terminal pleomere (Fig. 9D) lacking uropods but lateral margins and anal cone projecting equally posteriorly; tuft of three setae on each posterolateral corner.

*Variations.*—The paratype male is slightly smaller. Its pleon has been damaged, having been torn nearly apart in the middle of



the second pleomere. Otherwise, it is like the allotype in all characters.

**Etymology.**—The specific name *imbricata* refers to the overlapping arrangement of the holotype female's pleopods.

**Discussion.**—The characters of both sexes of *Parapagurion imbricata* are very similar to those of *P. calcincola* Shiino, the only previously recorded species of the genus, a parasite of *Calcinus elegans* (H. Milne Edwards) at Seto, Japan (Shiino, 1933). The female of *P. imbricata* differs from that of *P. calcincola* in having a well-developed maxillipedal palp and greatly reduced projections on the posteroventral border of the head. The male of *P. imbricata* differs from that of *P. calcincola* in having the eyes at the posterior edge of the head rather than far forward, in being relatively more slender and in having the terminal pleomere extended into three points rather than a single medial one.

#### Undescribed Genus and Species

**Diagnosis.**—**FEMALE:** Either dextral or sinistral, moderately distorted, about twice as long as broad, with reflexed frontal lamina along whole anterior edge; six pleomeres; five lateral plates; pleopods 1–2 biramous, pleopods 3–5 uniramous, all rami lanceolate; uropods biramous, endopodites minute, exopodites extended, oblong. **MALE:** Body to 40 or 50% as wide as long; head relatively large, extended; sides of pleon subparallel; pleon abruptly narrower than pereon, of six pleomeres, sixth much longer than others; no pleonal appendages, though uropods indicated by tuft of setae on posterolateral lobes of pleomere 6.

**Material examined.**—Infesting *Iridopagurus iris* (A. Milne Edwards), J. García-Gómez, det. of host. PILLSBURY Sta. P-757, off Península de Paraguaná, Venezuela, 11°41'N, 69°21'W, 161–187 m, 27 July 1968: 1 ♀, 1 ♂, USNM.

**Discussion.**—This species is currently being described elsewhere by Richard Heard as a parasite of *Pagurus annulipes* (Stimpson)

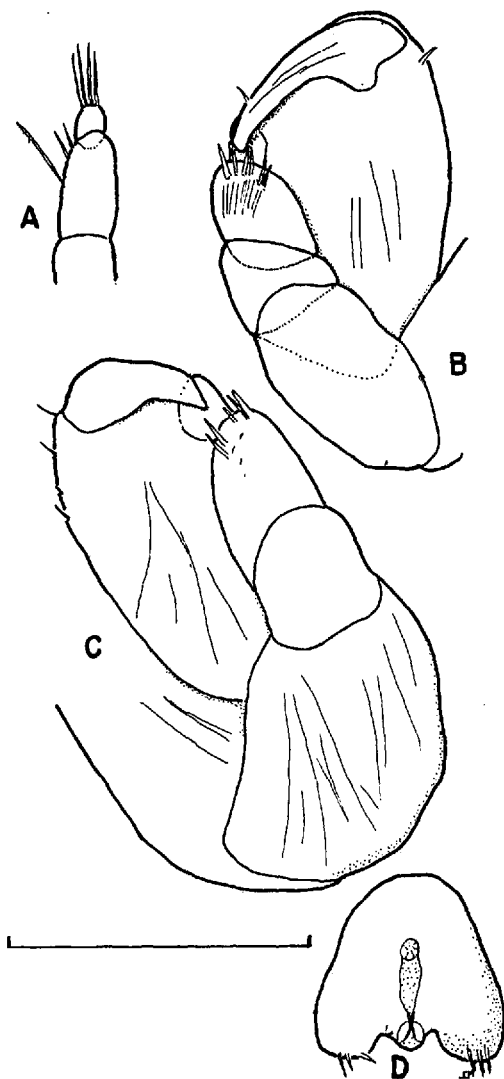


Figure 9. *Parapagurion imbricata*, n. sp., allotype male. A, Left antenna 1; B, Left pereopod 1; C, Right pereopod 6; D, Terminal pleomere, ventral. Scale: 0.08 mm for A; 0.10 for B–D.

from the coasts of North Carolina and Georgia. Thus only mention of it is made here. The female in the present material is somewhat contorted and difficult to assess; in contrast with the previously collected females, it is dextral. The male agrees well with the others known.

Subfamily ATHELGINAE Codreanu  
and Codreanu, 1956

*Stegophryxus* Thompson, 1902

Type-species, by original designation,  
*Stegophryxus hyptius* Thompson, 1902.  
Total number of species described, three.

*Stegophryxus hyptius* Thompson, 1902

*Stegophryxus hyptius* Thompson, 1902: 53–56,  
pls. 9, 10 (Type-locality, Woods Hole, Massa-  
chusetts).—Gosner, 1971: 476.—Markham,  
1974: 33–35, 38, 40, figs. 1–3 [Synonymy].

**Material examined.**—Infesting *Pagurus provenzan-  
noi* Forest and de Saint Laurent. Sta. JCM:D-150,  
off Portomaribaa, Curaçao, 12°13.0'N, 69°  
05.4'W, 15 m, on coral reef at night, 14 Apr.  
1974, J. C. Markham, coll., P. A. McLaughlin,  
det. of host: 1 ♀, 1 ♂, 3 cryptoniscan larvae,  
UMML 32.5356.

Infesting *Iridopagurus* sp. (probably new). Sta.  
JCM:D-146, off Portomaribaa, Curaçao, 12°  
13.0'N, 69°05.4'W, 15 m, on coral reef at night, 13  
Apr. 1974, J. C. Markham, coll., P. A. McLaughlin,  
det. of host: 1 ♀, 1 ♂, UMML 32.5357.

**Previous records.**—Infesting *Pagurus longi-  
carpus* Say in Massachusetts, Rhode Island  
and Georgia; *P. annulipes* (Stimpson) in  
North Carolina; *P. brevidactylus* (Stimp-  
son) in Florida; and *P. bonairensis* Schmitt  
in Florida.

**Discussion.**—The new material agrees in all  
essentials with that already described. Both  
of the host species are new records for this  
parasite, and the *Iridopagurus* sp. is the  
first recorded host not in the genus *Pagurus*.  
One of the host species was previously re-  
ported (Markham, 1974) as *Pagurus mi-  
amensis* Provenzano. McLaughlin (1975)  
has recently shown that that name is a junior  
synonym of *P. brevidactylus* (Stimpson).  
With the great extension of its recorded  
range to the southern Caribbean at Curaçao,  
*Stegophryxus hyptius* becomes latitudinally  
the most widely distributed of all western  
Atlantic species of marine bopyrids known.

*Stegias* Richardson, 1904

Type-species, by monotypy, *Stegias cli-  
banarii* Richardson, 1904. Total number of  
species described, three.

*Stegias clibanarii* Richardson, 1904  
Figure 10

*Stegias clibanarii* Richardson, 1904: 59–60, fig.  
34 (Type-locality, Bermuda).—McDermott,  
1974: 2.—Markham, 1975b: 225–230, figs.  
1, 2 [Synonymy]: 1975c: 260, 263.—[Cad-  
wallader], 1976:3.

**Material examined.**—Infesting *Clibanarius tricolor*  
(Gibbes), J. C. Markham, coll. and det. of hosts.  
At five localities in Bermuda (Whalebone Bay,  
Ferry Reach, Crawl Hill, Saucos Hill and Rocky  
Bay) in intertidal rocky pools, monthly samples,  
Aug. 1974 to May 1975: 45 ♀, nearly all with  
♂, BBS.

**Previous records.**—Type-specimens infest-  
ing *C. tricolor* at unknown specific locality,  
Bermuda (Richardson, 1904), doubtful rec-  
ord in Puerto Rico on same host species  
(Menziez and Glynn, 1968).

**Discussion.**—The type specimens of *Ste-  
gias clibanarii* have recently been rede-  
scribed (Markham, 1975b). The present  
material confirms that this species is occa-  
sionally quite abundant around Bermuda,  
which remains its only definitely known lo-  
cality. The new material has been col-  
lected as part of a continuing study of the  
host species, *Clibanarius tricolor*, in Ber-  
muda and will be reported on in detail at  
the end of that study. At that time, some  
of the specimens will be assigned to other  
museums. Some of the females are imma-  
ture, and one of them is illustrated (Fig.  
10). It corresponds in all essential charac-  
ters with the holotype, but some proportions  
are different. The body is relatively longer,  
and the pleonal appendages, especially the  
dorsally placed uropods, are much smaller.  
Eyes are present, near the anterolateral  
corners of the head; this is almost certainly  
the normal condition for this species, the  
eyes of the holotype having been lost in  
long preservation. All males examined  
when fresh also bore eyes.

**Coloration of fresh material.**—FEMALE:  
Background white to pale tan; eyespots  
black; pereon usually orange medially be-  
cause of eggs in ovary and brood pouch;  
digestive tract orange-red or brick-red, visi-  
ble from pereomere 1 to pleomere 1, split

into two parts in pereomere 1. MALE: Background glassy white to brownish; eyes as tiny black points; pigment similar to eyes irregularly scattered on pereon and pleon; digestive tract red-orange, extending from posterior margin of pereomere 2 to anterior region of pleon, there frequently splitting and fading away. As with the types, all males occur within the brood pouches of the females, where they are clearly visible in fresh material because of their colors.

*Parathelges* Bonnier, 1900

Type-species, by original designation, *Athelges aniculi* Whitelegge, 1897. Total number of species described, 11.

*Parathelges foliatus* Markham, 1972

Figure 11

*Parathelges foliatus* Markham, 1972: 73-75, figs. 14, 15 (Type-locality, Trinidad).

**Material examined.**—Infesting *Pagurus brevidactylus* (Stimpson), P. A. McLaughlin, det. of hosts. Oistins Bay, Barbados, 4 May 1974, P. A. McLaughlin and E. J. McGeorge, colls.: 1 ♀, 1 ♂ (reference ♂), USNM. Exact locality unknown, Curaçao, 28 Aug. 1963, B. A. Hazlett, coll.: 2 ♀, 2 ♂, UMML.

**Previous record.**—Holotype infesting *Clibanarius vittatus* (Bosc) at Port of Spain, Trinidad.

Description of male (based on reference male). Fig. 11.

**Dimensions.** Length 2.0 mm, maximal width 0.8 mm, head length 0.3 mm, pleon length 0.5 mm.

Body regions and pereomeres all distinctly separated, sides of body nearly parallel (Fig. 11A, B).

Head approximately semicircular in outline. Eyes moderately large, near posterior border of head. Antennae (Fig. 11C) both bearing numerous setae distally; antenna 1 of three segments, antenna 2 of five to eight segments.

Pereon broadest across pereomere 5, but only slightly so. Pereopods (Fig. 11D, E) all well-developed, first two larger and with proportionately much larger dactyli than

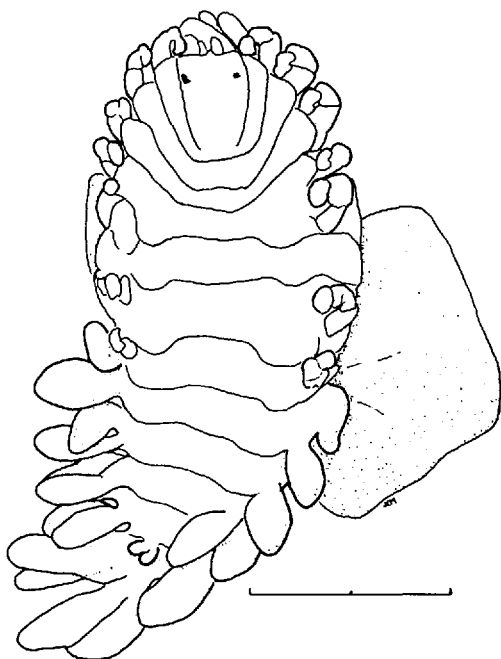


Figure 10. *Stegias clibanarii* Richardson, immature female, dorsal. Scale: 1.0 mm.

others; carpus of each with distal tuft of setae.

Pleon nearly triangular, fused into single piece, somewhat narrower anteriorly than final pereomere. No pleonal appendages.

**Discussion.**—The other two males examined agree in essentially all characters with the reference specimen, and the same is true for the females in comparison with the holotype. This is the first record of a male for this species, and, while differing from all other males in the genus, it shows all of the characters typical for males of *Parathelges* (Markham, 1972). The new material extends the known range of *Parathelges foliatus* farther through the Lesser Antilles; this is also a new host record. Of the other species of *Parathelges* described, the male of *P. foliatus* is most similar to that of *P. tumidipes* Markham, from which it differs in having the posterior border of the head straight rather than extended into the pereon, in having less separated pereomeres

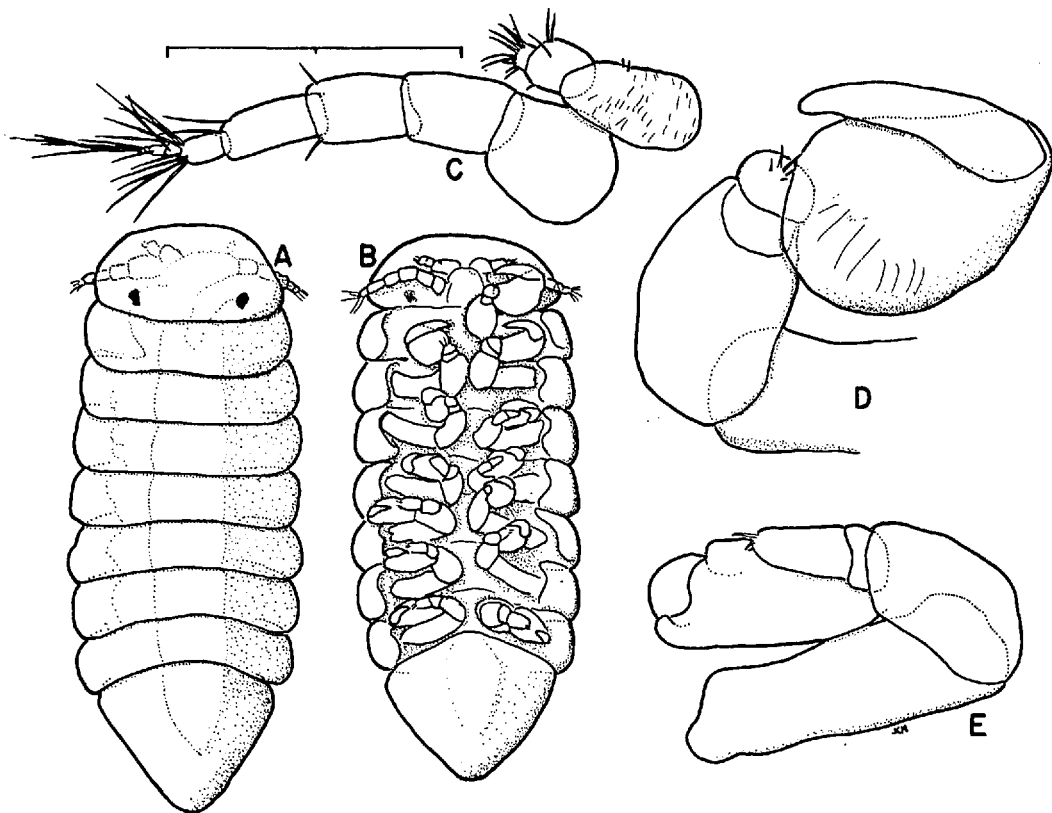


Figure 11. *Parathelges foliatus* Markham, reference male. A, Dorsal; B, Ventral; C, Right antennae; D, Left pereopod 1; E, Right pereopod 7. Scale: 1.0 mm for A, B; 0.2 mm for C-E.

and in having the anterior edge of the pleon narrower than the final pereomere.

*Parathelges occidentalis* Markham, 1972

*Parathelgas occidentalis* Markham, 1972: 60-69, figs. 1-9 (Type-localities, Dry Tortugas, Florida, and Berry Islands, Bahamas).

**Material examined.**—Infesting unknown host (either not collected or separated from parasite). Unrecorded collection data, "probably Trinidad": 1 ♀ (damaged), USNM 29231.

**Previous records.**—Infesting *Pylopagurus corallinus* (Benedict) of coast of North Carolina; *Clibanarius tricolor* (Gibbes), in Berry Islands, Bahamas, and Florida Keys; and *Iridopagurus* sp., near Isla de Margarita, Venezuela.

**Discussion.**—The new material, if the inadequate label with the specimen is correct, extends the known range of this species slightly. Since previous records are from host species belonging to three different genera in two different families, it is impossible to judge what species might have been the host in this case. According to Thomas E. Bowman (personal communication), the specimen was catalogued in 1903.

*Parathelges piriformis* Markham, 1972

*Parathelges piriformis* Markham, 1972: 71-73, figs. 12, 13 (Type-locality, Bermuda).

**Material examined.**—Infesting *Pagurus provenzanoi* Forest and de Saint Laurent. Sta. JCM:D-94, on coral reef, east side Andros Island, Bahamas, 24°53'N, 77°53'W, 15 m, 10 Sep. 1973, J. C.

Markham, coll., P. A. McLaughlin, det. of host: 1 ♀, 1 ♂, UMML 32.5371.

Infesting *Paguristes oxyphthalmus* Holthuis. PILLSBURY Sta. P-365, off Golfo de Morrosquilla, Colombia, 09°32'N, 76°16'W, 57 m, 13 July 1966, L. B. Holthuis, det. of host: 1 ♀, 1 ♂, UMML.

*Previous record.*—Type-specimens infesting *Pagurus brevidactylus* (Stimpson) in Bermuda.

*Discussion.*—The new material adds two new host species to that originally known for *Parathelges piriformis* and extends its known range far southward, from Bermuda to Colombia. The host of the types was originally listed as *Pagurus miamensis* Provenzano. The new material does not differ significantly from the types.

#### *Parathelges tumidipes* Markham, 1972

*Parathelges tumidipes* Markham, 1972: 66–71, figs. 10, 11 (Type-locality, near Jamaica).

*Material examined.*—Infesting *Allodardanus bredini* Haig and Provenzano. Two miles southeast of Castle Roads, Bermuda, 32°19'N, 64°38'W, 450 m, 16 Oct. 1974, J. H. R. Lightbourn and A. T. Guest, colls., J. C. Markham, det. of host: 1 ♀, 1 ♂, BBS.

*Previous record.*—Type-specimens infesting *Dardanus fucosus* Biffar and Provenzano, southwest of Jamaica.

*Discussion.*—The new material is a new host record and a considerable northward extension of the known range for *Parathelges tumidipes*. Additional material is being collected as part of an ongoing study of the host species and will be reported on in detail later, and collected material will be donated to other museums. The new material is substantially identical to the types. The host of the type-specimens was not identified in the original description because its description as a new species, *Dardanus fucosus*, was still in press.

#### Unidentified Athelgine Bopyrids

*Material examined.*—Infesting *Paguristes* sp. (probably new). Sta. JCM:D-70, off west end of Providenciales Island, Turks and Caicos Islands, 21°50'N, 72°21'W, 20 m, on coral reef, 1 Sep. 1973, J. C. Markham, coll., P. A. McLaughlin, det. of host: 1 ♀ (immature), 1 cryptoniscan larva, UMML.

Infesting *Tomopagurus cokeri* (Hay). PILLSBURY

Sta. P-594, off Yucatan Peninsula, Mexico, 21° 00'N, 86°23'W, 330 m, 15 Mar. 1968, P. A. McLaughlin, det. of host: 1 ♀, 1 ♂ (both immature), UMML.

*Discussion.*—These parasites are so immature that it is impossible to identify them even to genus, although all of them appear closest to *Parathelges*. It is probable that they belong to one or two of the species considered above.

#### CONCLUSIONS

Although new species, and certainly new host and geographic records for known species, will undoubtedly turn up in the future, the foregoing report of 11 species is probably a fairly comprehensive picture of the bopyrids infesting hermit crabs in the northwestern Atlantic Ocean. In this region, the bopyrid parasites of hermit crabs are found almost exclusively in tropical or subtropical waters. The only species found in temperate waters is *Stegophryxus hyptius*, which appears to achieve a population maximum in Massachusetts, even though it is also known nearly to South America. E. L. Bousfield (personal communication) has made intensive surveys of the hermit crabs of eastern Canada but has failed to find any bearing bopyrids there. Elsewhere, *Pseudione hyndmanni* (Bate and Westwood) is a fairly common parasite of hermit crabs in the Arctic Ocean off Europe (Gurjanova, 1932), and *Pseudione giardi* Calman is recorded as a parasite of *Pagurus* spp. as far north as the Bering Sea coast of Alaska (Markham, 1975a).

All of the hermit-crab infesting bopyrids in the northwestern Atlantic belong to genera represented elsewhere in the world's oceans. The genera *Bopyrissa*, *Asymmetrione* and *Parathelges* are pantropical, being found in all warm-water regions. The other species of *Parapagurion* occurs in Japan, *Stegias* is otherwise represented by a species on each side of the Pacific, and there are two other species of *Stegophryxus* on the west coast of the Americas. All of the genera discussed in this report are repre-

Table 1. Hermit crabs recorded as hosts of bopyrid isopods in the northwestern Atlantic, their parasites and localities

| Species                        | Parasite                        | Locality (or localities)                        |
|--------------------------------|---------------------------------|---|
| <b>Family Paguridae</b>        |                                 |   |
| <i>Iridopagurus iris</i>       | Undescribed pseudionine         | Venezuela                                       |
| <i>Iridopagurus</i> sp.        | <i>Stegophryxus hyptius</i>     | Curaçao   |
| <i>Iridopagurus</i> sp.        | <i>Parathelges occidentalis</i> | Venezuela                                       |
| <i>Pagurus annulipes</i>       | Undescribed pseudionine         | North Carolina; Georgia                         |
|                                | <i>Stegophryxus hyptius</i>     | North Carolina                                  |
| <i>P. bonairensis</i>          | <i>Asymmetrione desultor</i>    | S. Florida                                      |
|                                | <i>Stegophryxus hyptius</i>     | S. Florida                                      |
| <i>P. brevidactylus</i>        | <i>Stegophryxus hyptius</i>     | S. Florida                                      |
|                                | <i>Parathelges piriformis</i>   | Bermuda   |
|                                | <i>Parathelges foliatus</i>     | Barbados; Curaçao                               |
| <i>P. longicarpus</i>          | <i>Asymmetrione desultor</i>    | North Carolina                                  |
|                                | <i>Stegophryxus hyptius</i>     | Massachusetts; Rhode Island; Georgia            |
| <i>P. provenzano</i>           | <i>Asymmetrione desultor</i>    | Antigua; Curaçao; Bonaire                       |
|                                | <i>Stegophryxus hyptius</i>     | Curaçao   |
|                                | <i>Parathelges piriformis</i>   | Bahamas   |
| <i>Pylopagurus corallinus</i>  | <i>Parathelges occidentalis</i> | North Carolina                                  |
| <i>Pylopagurus</i> sp.         | <i>Asymmetrione desultor</i>    | Florida Keys; Cay Sal Bank                      |
| <i>Tomopagurus cokeri</i>      | Unidentified athelgine          | Yucatan   |
| <b>Family Parapaguridae</b>    |                                 |   |
| <i>Paragurus</i> sp.           | <i>Parapagurion imbricata</i>   | Colombia  |
| <b>Family Diogenidae</b>       |                                 |   |
| <i>Allodardanus bredini</i>    | <i>Parathelges tumidipes</i>    | Bermuda   |
| <i>Clibanarius tricolor</i>    | <i>Asymmetrione clibanarii</i>  | S. Florida; Berry Islands                       |
|                                | <i>Bopyrissa wolffi</i>         | Bermuda; S. Florida; Berry Islands; Puerto Rico |
|                                | <i>Stegias clibanarii</i>       | Bermuda; Puerto Rico (?)                        |
|                                | <i>Parathelges occidentalis</i> | Florida Keys; Berry Islands                     |
| <i>C. vittatus</i>             | <i>Bopyrissa wolffi</i>         | North Carolina; Texas                           |
|                                | <i>Parathelges foliatus</i>     | Trinidad  |
| <i>Clibanarius</i> sp.         | <i>Asymmetrione clibanarii</i>  | Ascension                                       |
| <i>Dardanus fucosus</i>        | <i>Parathelges tumidipes</i>    | Jamaica   |
| <i>Paguristes oxyphthalmus</i> | <i>Parathelges piriformis</i>   | Colombia  |
| <i>P. tortugae</i>             | <i>Parapagurion imbricata</i>   | N. Cuba   |
| <i>Paguristes</i> sp.          | Unidentified athelgine          | Turks and Caicos Islands                        |

sented worldwide by species exclusively parasitic on hermit crabs.

Faunistically, the most poorly known region of the Atlantic is probably the coast of South America from the northern border of Brazil southward. In all of that distance, approximately 60 degrees of latitude, only three species of bopyrids infesting paguroids have been recorded. Müller (1871) described the species now known as *Anathelges resupinatus* (Müller) as a parasite of an unidentified hermit crab at Desterro

(now Florianópolis), Brazil. Unfortunately, his description was extremely deficient, his material evidently has been lost, and no one has recorded the species since, even though Müller reported collecting many specimens. Lemos de Castro (1965) described the only other species of bopyrid known to infest a hermit crab along the Atlantic coast of South America, *Pseudostegias atlantica*, a parasite of a *Clibanarius* sp. at two Brazilian localities. The third species recorded from a southwestern At-

lantic paguroid infests not a hermit crab but the lithodid *Lithodes diomedea* Benedict. It is *Pseudione tuberculata* Richardson taken in deep water off Port Ortway, Patagonia, Argentina (Richardson, 1904). Further collections along that coast should produce more species of bopyrids infesting paguroids.

The geographical and host distributions of the species discussed above are greatly varied. One permissible generalization about them is that the branchially infesting pseudionines are more restricted in their host selection than the abdominally infesting athelgines. Although four pseudionines of five recorded infest more than a single host species, only three of them infest hosts in different genera, and, of these, only *Parapagurion imbricata* infests hosts of different families. In contrast, only *Stegias clibanarii* among six athelgines is recorded from a single host species or even genus, and three species of *Parathelges* infest members of different families. In general, those parasites with the greatest geographical ranges also have the greatest numbers of recorded host species; thus *Stegophryxus hyptius*, from Massachusetts to Curaçao, infests hosts belonging to six different species. *Asymmetri-one desultor*, the only species of its genus known to infest pagurids (mostly in the genus *Pagurus*), is also the one with the greatest known range and number of species of hosts; between North Carolina and Curaçao, it infests four different pagurids.

To complement the above records, Table 1 lists all of the recorded northwestern Atlantic hermit crab hosts alphabetically in their families with the parasites known to infest them in different localities.

#### ACKNOWLEDGMENTS

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- NOTE ADDED IN PROOF: Recently Daniel Adkison allowed me to examine specimens of *Stegophryxus hyptius* infesting *Pagurus* sp. (? *P. annulipes*) in the Gulf of Mexico at St. Petersburg, Florida, and off the coast of Mississippi. This is a significant extension of range for *S. hyptius*.
- DATE ACCEPTED: January 14, 1977.
- ADDRESS: Bermuda Biological Station for Research, St. George's West, 1-15, Bermuda.